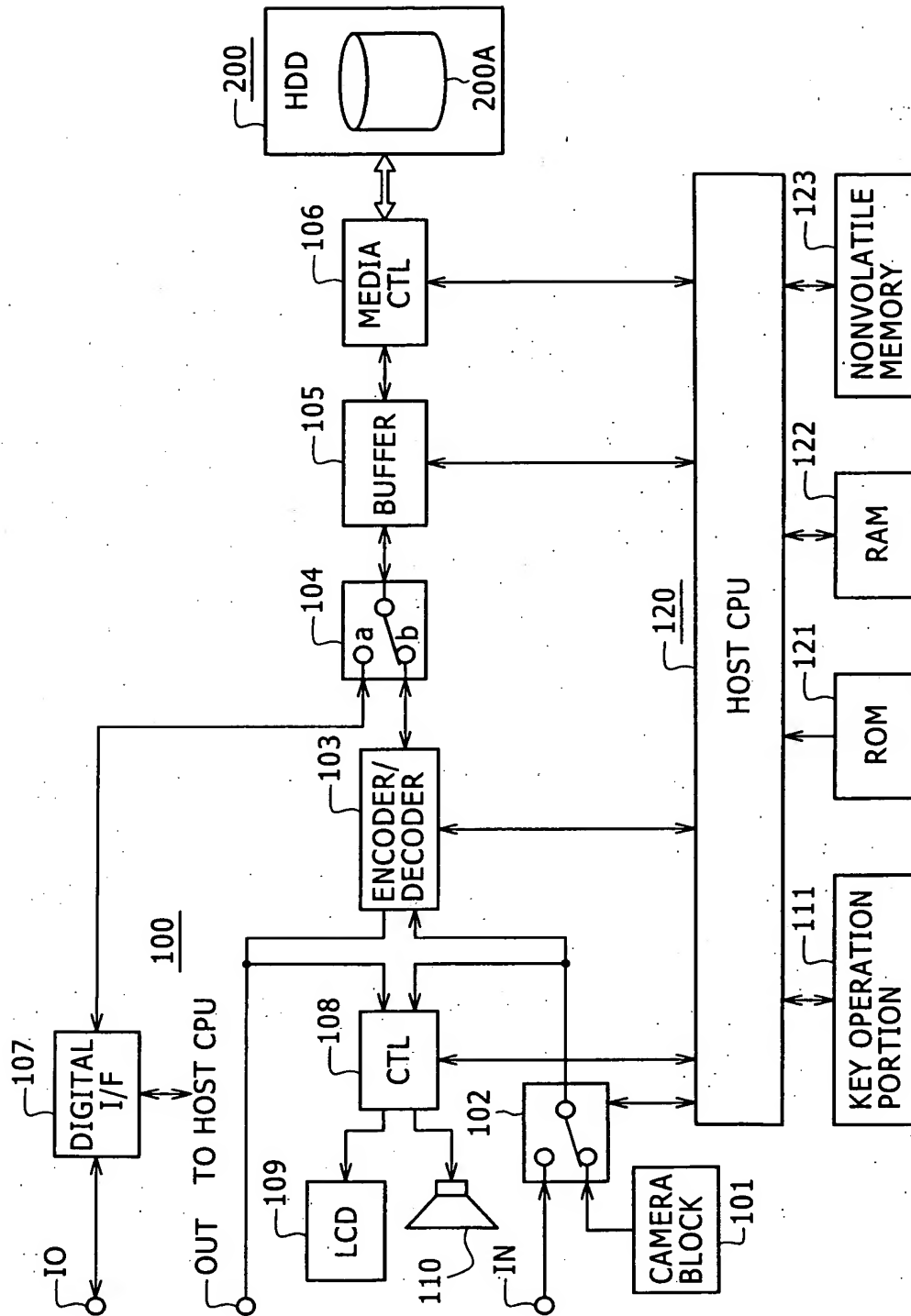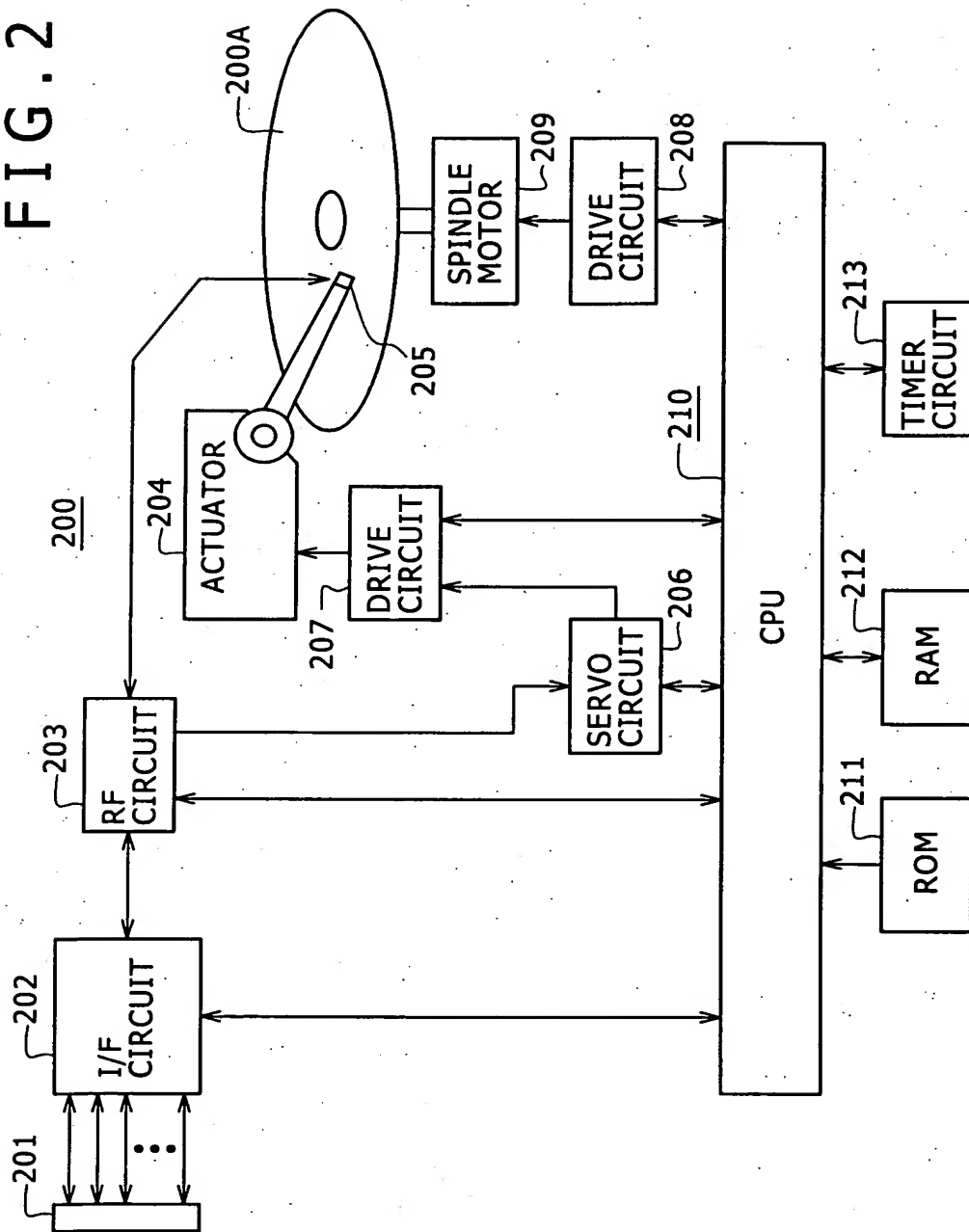FIG. 1

FIG.2

FIG. 3

POWER SAVE MODES OF INFORMATION STORAGE DEVICE (HDD)

CIRCUIT PORTION \ MODE	IF CIRCUIT	SPINDLE	ACTUATOR	SERVO CIRCUIT	RF CIRCUIT	EXAMPLE OF POWER CONSUMPTION
ACTIVE	Enable	Rotating	Load (ON DISK)	ON	Enable	READ 2.1W / WRITE 2.2W
LOW POWER ACTIVE (PERFORMANCE IDLE)	Enable	Rotating	Load (ON DISK)	ON	Enable	1.85W
ACTIVE IDLE	Enable	Rotating	Load (ON DISK)	OFF	Disable	0.95W
LOW POWER IDLE	Enable	Rotating	Parking (OUT OF DISK)	OFF	Disable	0.65W
STANDBY	Enable	Stop	Parking (OUT OF DISK)	OFF	Disable	0.25W
SLEEP	Lowest	Stop	Parking (OUT OF DISK)	OFF	Disable	0.10W

F I G . 4 A

(W)

WRITE
(2.2 W)

(1.85 W)
LOW POWER
ACTIVE

10 Mbits IN TOTAL

1 SEC

(T)

0.05 SEC × 2200 mW + 0.95 SEC × 1850 mW = 1868 mW

F I G . 4 B

(W)

WRITE
(2.2 W)

(1.85 W)

ACTIVE IDLE
(0.95 W)

10 Mbits

MODE TRANSITION
TIME

ACTIVE IDLE

10 Mbits

1 SEC

0.05 SEC

0.2 SEC

0.75 SEC

(T)

0.05 SEC × 2200 mW + 0.2 SEC × 1850 mW + 0.75 SEC × 950 mW = 1193 mW

F I G . 5

10 Mbits

1 SEC

(W)

WRITE
(2.2 W)

(1.85 W)
LOW POWER
ACTIVE

(0.95 W)
ACTIVE
IDLE

ACTIVE IDLE

0.05 SEC

0.95 SEC

(T)

0.05 SEC × 2200 mW + 0.95 SEC × 950 mW = 1013 mW
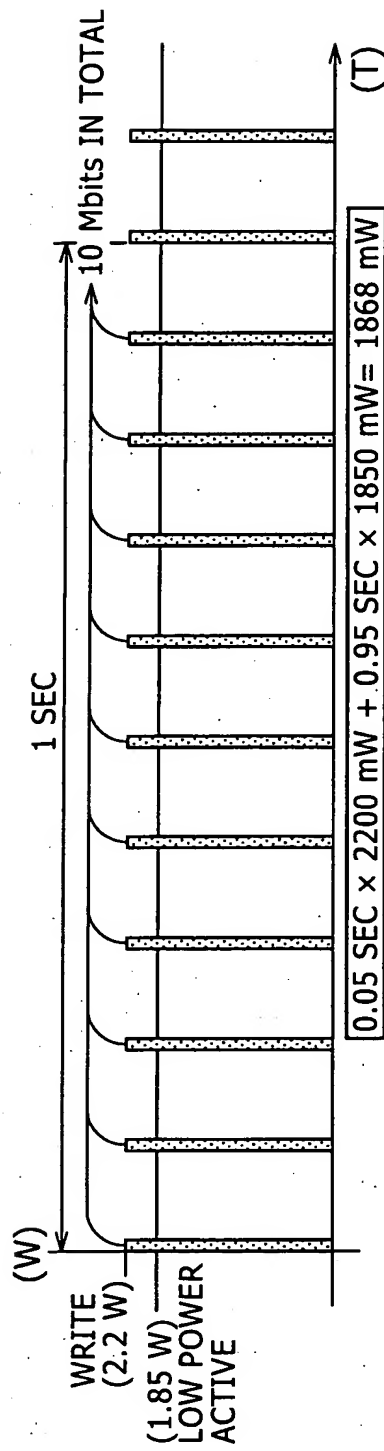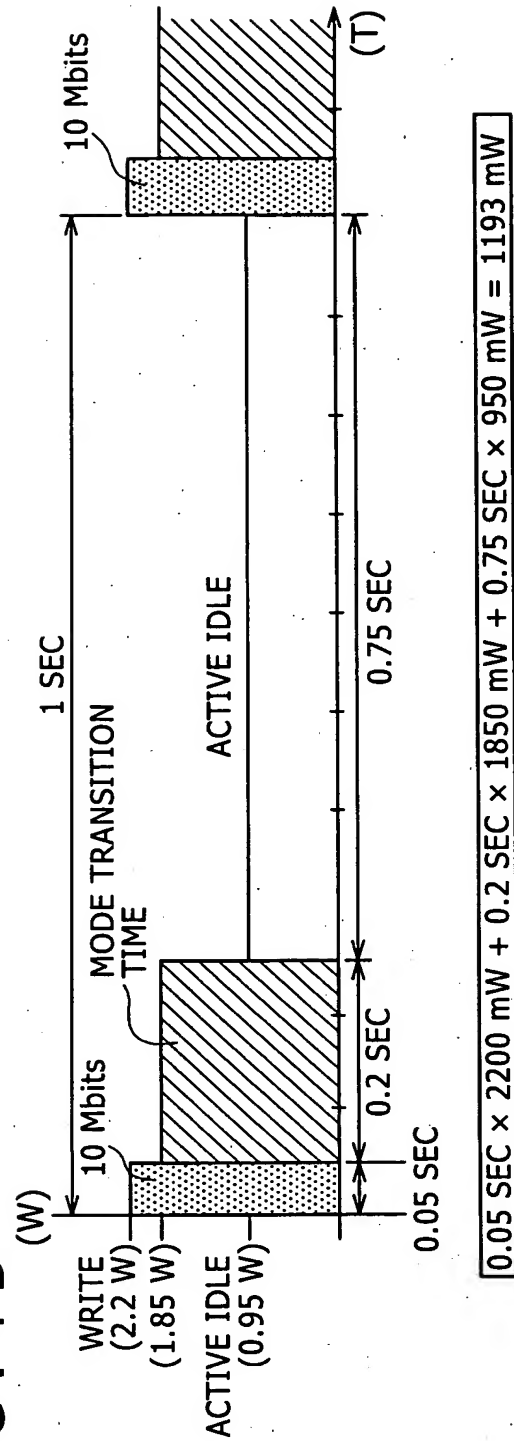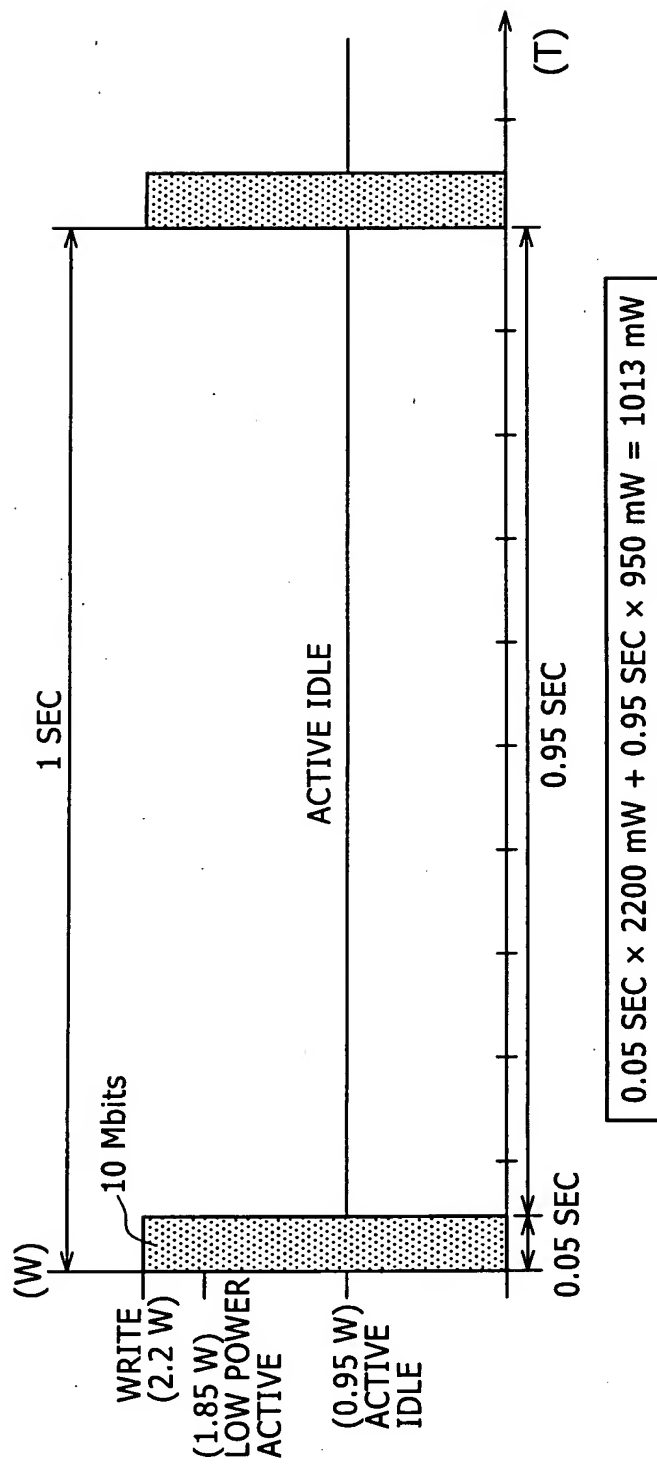
FIG.6

COMMAND CODE: EFh

REGISTERS	7	6	5	7	3	2	1	0
FEATURES	SUBCOMMAND CODE							
SECTOR COUNT	SUBCOMMAND SPECIFIC							
SECTOR NUMBER	SUBCOMMAND SPECIFIC							
CYLINDER LOW	SUBCOMMAND SPECIFIC							
CYLINDER HIGH	SUBCOMMAND SPECIFIC							
DEVICE/HEAD	obs	na	obs	DEV	na	na	na	na
COMMAND	EFh							

obs : obsolete   na : not applicable

FIG.7

VALUE	DESCRIPTION
01h	Enable 8-bit PIO transfer mode
02h	Enable write cache
03h	Set transfer mode based on value in Sector Count register
04h	Obsolete
05h	Enable Advanced Power Management
⋮	⋮
* 25h	Enable Direct Power Management
* 26h	Set Host Controlled Advanced Power Management
⋮	⋮
85h	Disable Advanced Power Management
⋮	⋮
* A5h	Disable Direct Power Management
⋮	⋮

SET FEATURES COMMAND

FIG.8A

REGISTERS	7	6	5	4	3	2	1	0	
FEATURES	0	0	1	0	0	1	0	1	(25h)
DEVICE/HEAD	1	0	1	0	0	0	0	0	(A0h)
COMMAND	1	1	1	0	1	1	1	1	(EFh)

FIG.8B

REGISTERS	7	6	5	4	3	2	1	0	
FEATURES	1	0	1	0	0	1	0	1	(A5h)
DEVICE/HEAD	1	0	1	0	0	0	0	0	(A0h)
COMMAND	1	1	1	0	1	1	1	1	(EFh)

FIG.9

COMMAND CODE: EFh

REGISTERS	7	6	5	4	3	2	1	0
FEATURES	na							
SECTOR COUNT	na							
SECTOR NUMBER	na							
CYLINDER LOW	na							
CYLINDER HIGH	na							
DEVICE/HEAD	obs	na	obs	DEV	na	na	na	na
COMMAND	E1h							

obs : obsolete   na : not applicable

FIG.10

VALUE	DESCRIPTION
00h	Active Immediate
01h	Low Power Active Immediate
02h	Active Idle Immediate
03h	Low Power Idle Immediate

IDLE IMMEDIATE COMMAND

FIG.11A

REGISTERS	7	6	5	4	3	2	1	0	
FEATURES	0	0	0	0	0	0	0	0	(00h)
DEVICE/HEAD	1	0	1	0	0	0	0	0	(A0h)
COMMAND	1	1	1	0	0	0	0	1	(E1h)

FIG.11B

REGISTERS	7	6	5	4	3	2	1	0	
FEATURES	0	0	0	0	0	0	0	1	(01h)
DEVICE/HEAD	1	0	1	0	0	0	0	0	(A0h)
COMMAND	1	1	1	0	0	0	0	1	(E1h)

FIG.11C

REGISTERS	7	6	5	4	3	2	1	0	
FEATURES	0	0	0	0	0	0	1	0	(02h)
DEVICE/HEAD	1	0	1	0	0	0	0	0	(A0h)
COMMAND	1	1	1	0	0	0	0	1	(E1h)

FIG.11D

REGISTERS	7	6	5	4	3	2	1	0	
FEATURES	0	0	0	0	0	0	1	1	(03h)
DEVICE/HEAD	1	0	1	0	0	0	0	0	(A0h)
COMMAND	1	1	1	0	0	0	0	1	(E1h)

FIG.12A

COMMAND CODE: E5h

REGISTERS	7	6	5	4	3	2	1	0
FEATURES	na							
SECTOR COUNT	na							
SECTOR NUMBER	na							
CYLINDER LOW	na							
CYLINDER HIGH	na							
DEVICE/HEAD	obs	na	obs	DEV	na	na	na	na
COMMAND	E5h							

obs : obsolete   na : not applicable

FIG.12B

REGISTERS	7	6	5	4	3	2	1	0
ERROR	na							
SECTOR COUNT	Result Value							
SECTOR NUMBER	na							
CYLINDER LOW	na							
CYLINDER HIGH	na							
DEVICE/HEAD	obs	na	obs	DEV	na	na	na	na
STATUS	BSY	DRDV	DF	na	DRQ	na	na	ERR

obs : obsolete   na : not applicable

FIG.13A

VALUE	DESCRIPTION
00h	STANDBY MODE
80h	IDLE MODE
FFh	ACTIVE MODE OR IDLE MODE

FIG.13B

VALUE	DESCRIPTION
FFh	ACTIVE MODE
83h	LOW POWER ACTIVE MODE
82h	ACTIVE IDLE MODE
81h	LOW POWER IDLE MODE
00h	STANDBY MODE

FIG.14

(W)

ACTIVE

LOW POWER
ACTIVE

TRANSITION
TIME T1

TRANSITION
TIME T2

ACTIVE IDLE

LOW POWER
IDLE

TRANSITION
TIME T3

TRANSITION
TIME T4

STANDBY

SLEEP

(t)
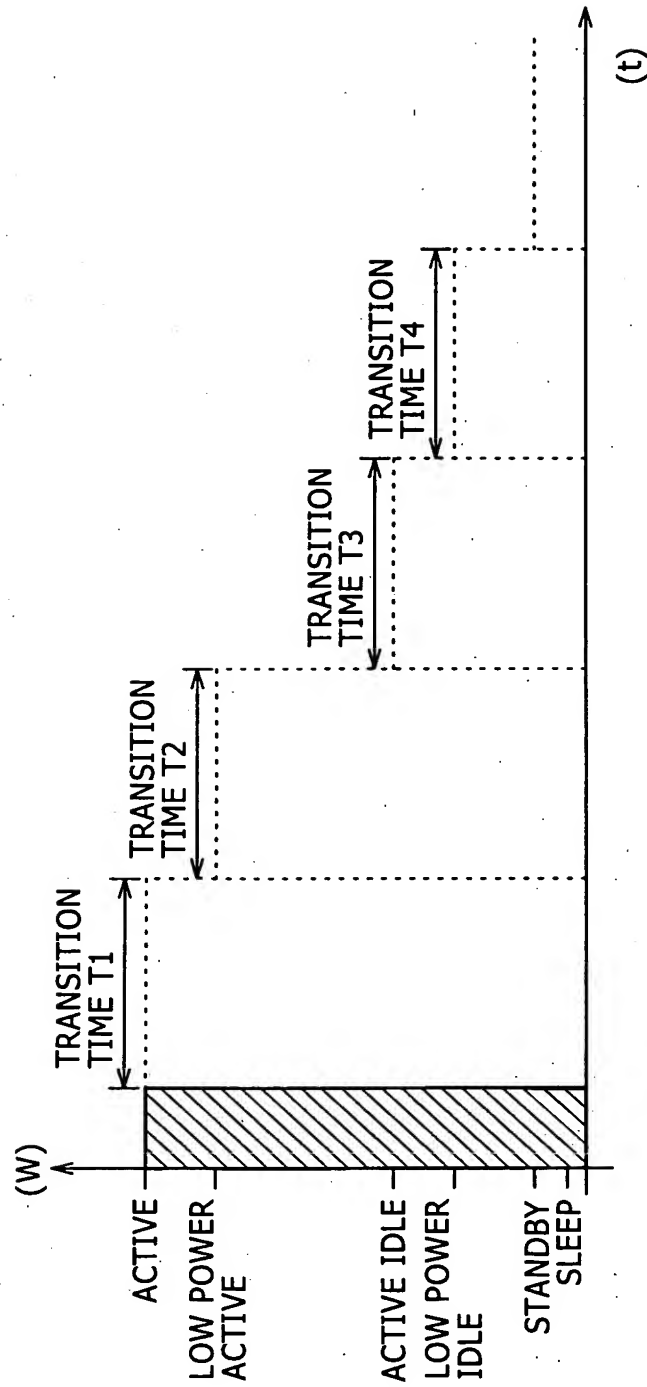
FIG.15

COMMAND CODE: EFh

REGISTERS	7	6	5	4	3	2	1	0
FEATURES				26h				
SECTOR COUNT				(00h ~ 03h)				
SECTOR NUMBER				(00h ~ FFh)				
CYLINDER LOW				na				
CYLINDER HIGH				na				
DEVICE/HEAD	obs	na	obs	DEV	na	na	na	na
COMMAND				EFh				

obs : obsolete   na : not applicable

F I G . 1 6

| VALUE	DESCRIPTION
00h	SPECIFY TRANSITION TIME FROM ACTIVE TO LOW POWER ACTIVE
01h	SPECIFY TRANSITION TIME FROM LOW POWER ACTIVE TO ACTIVE IDLE
02h	SPECIFY TRANSITION TIME FROM ACTIVE IDLE TO LOWER POWER IDLE
03h	SPECIFY TRANSITION TIME FROM LOWER POWER IDLE TO STANDBY

FIG.17

VALUE IN SECTOR NUMBER REGISTER $\times$ 40 msec = SET TIME $\cdots$ (1)

FIG. 18

LIST OF POWER CONSUMPTION CONTROL FUNCTIONS

SETTING			OPERATION			
SETTING OF DIRECT POWER MANAGEMENT	SETTING OF STANDBY TIMER	SETTING OF ADVANCED POWER MANAGEMENT FOR PC	STADBY TIMER	ADVANCED POWER MANAGEMENT FOR PC	HOST CONTROLLED ADVANCED POWER MANAGEMENT	DIRECT POWER MANAGEMENT
DISABLED (DEFAULT)	DISABLED (DEFAULT)	ENABLED (DEFAULT)	× DISABLED	○ ENABLED APM Mode 0	× DISABLED	× DISABLED
		DISABLED				
	ENABLED	ENABLED (DEFAULT)	○ ENABLED	○ ENABLED APM Mode 0	× DISABLED	× DISABLED
		DISABLED				
DISABLED (DEFAULT)	DISABLED (DEFAULT)	ENABLED (DEFAULT)	× DISABLED	× DISABLED	○ ENABLED	○ ENABLED
		DISABLED				
	ENABLED	ENABLED (DEFAULT)	○ ENABLED	× DISABLED	○ ENABLED	○ ENABLED
		DISABLED				

FIG.19

```
                    ┌──────────┐
                    │  START   │
                    └──────────┘
                         │
                         │  ┌─ S101
                         ▼
        ┌────────────────────────────────┐
        │ CONTROL POWER CONSUMPTION      │
        │ MODE BY APM FUNCTION           │
        └────────────────────────────────┘
                         │
                         │  ┌─ S102
                         ▼
               ◇ ENABLING              NO
               ◇ DPM FUNCTION  ──────────┐
               ◇ INSTRUCTED?             │
                         │               │
                       YES               │
                         │  ┌─ S103      │
                         ▼               │
        ┌────────────────────────────────┐
        │ ENABLE DPM FUNCTION AND        │
        │ HCAPM FUNCTION, AND STOP       │
        │ APM FUNCTION                   │
        └────────────────────────────────┘
                         │
                         │  ┌─ S104
                         ▼
               ◇ DISABLING             NO
               ◇ DPM FUNCTION  ──────────┐
               ◇ INSTRUCTED?             │
                         │               │
                       YES               │
                         │  ┌─ S105      │
                         ▼               │
        ┌────────────────────────────────┐
        │ DISABLE DPM FUNCTION AND       │
        │ HCAPM FUNCTION                 │
        └────────────────────────────────┘
                         │
                         └───────────────┘
```

F I G . 2 0

```
          ┌──────────────┐
          │    START     │
          └──────┬───────┘
                 │  ⌐S101
                 ▼
   ┌─────────────────────────────┐
   │ ISSUE CHECK POWER MODE       │
   │ COMMAND FROM INFORMATION     │
   │ PROCESSING UNIT              │
   └─────────────┬───────────────┘
                 │  ⌐S202
                 ▼
   ┌─────────────────────────────┐
   │ ACCEPT CHECK POWER MODE      │
   │ COMMAND AT HDD               │
   └─────────────┬───────────────┘
                 │  ⌐S203
                 ▼
            ◇ DPM FUNCTION ◇  ─── NO
            ◇ ENABLED?     ◇
                 │ YES
                 │  ⌐S204
```

START

S101

ISSUE CHECK POWER MODE COMMAND FROM INFORMATION PROCESSING UNIT

S202

ACCEPT CHECK POWER MODE COMMAND AT HDD

S203

DPM FUNCTION ENABLED?

NO

YES

S204

SET POWER CONSUMPTION MODE AS RETURN VALUE FOR CHECK POWER MODE COMMAND AT DETAILED LEVEL

S205

SET POWER CONSUMPTION MODE AS RETURN VALUE FOR CHECK POWER MODE COMMAND AT ROUGH LEVEL

S206

REFER TO RETURN VALUE AT INFORMATION PROCESSING UNIT

END